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COMMENTARY

# Blending Information and Communication Technology with Accounting Research

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## INTRODUCTION

The purpose of this commentary is to explore how information and communication technologies (ICT) have forever changed many aspects of business and accounting practice and, as a result, offer new and exciting research opportunities to accounting professionals and academics. In today's computerized, interconnected, global business environment, the accounting profession must deal with a host of complex issues that never existed in the past—for instance, how to capture and record new business transactions and events, develop value-added business and information processes, create new value-chain and supply-chain opportunities, disseminate useful knowledge to a wide array of information consumers, and provide assurance services across the entire spectrum of economic activities reflect some of the more compelling topics of interest. Accounting researchers can add value to the profession by investigating these issues, among others, and presenting scientific results in a clear and understandable fashion to practicing accountants.

An important message of this commentary is that researchers in accounting information systems (AIS) and other areas of accounting, such as financial, auditing, tax, and managerial, should work together on projects, as each party can learn a great deal from the other. Synergistic relationships arising from such teamwork hold great potential to yield high-quality research results that can have notable impact on the accounting profession.

## THE NEW BUSINESS AND ACCOUNTING LANDSCAPE

Over the past centuries, business practices and accounting procedures developed and matured a great deal, yet at a relatively predictable, slow, and controlled rate. We stand squarely, proudly, and respectfully on the broad shoulders of those who came before us, as their guidance, wisdom, and insight masterfully steered us to this place and time in the profession. However, in the apparent twinkling of an eye, ICT has disrupted our peaceful existence by radically transforming the manner in which

business is conducted across the world and alerting us to the many challenges that lay ahead.

## How Technology Affects Business Practice

There is little doubt that ICT has contributed immensely to the magnitude, speed, and acceleration of change in business practice over the past three decades. Rapid changes in the business world place immense pressure on business executives to stay ahead of the competition by leveraging ICT to dramatically and continually redesign business processes and models.

### *Using ICT to Create a Digitally Integrated Entity*

Figure 1 depicts an ICT infrastructure that envelopes and permeates the input-process-output value chain of a business entity. Encapsulated by this ICT infrastructure, digitally integrated business entities capture economic events as they unfold, process information with instantaneous speed and ubiquitous availability, and disseminate valuable decision-making information and knowledge throughout the organization. The blending of ICT and business process integration manifests itself in enterprise resource planning (ERP) systems, which serve as the foundation for linking multiple, related business entities into integrated supply chains.

### *Using ICT to Integrate the Conventional Supply Chain*

When related entities link their internally integrated information systems to one another, the value of the interconnected network potentially becomes greater than the sum of the participating firms' isolated systems. The supply chain illustrated in Figure 2 depicts how a digitally integrated business environment might look, assuming that conventional relationships among upstream and downstream partners remain intact. Suppliers can monitor upcoming production schedules of manufacturers to ensure that the proper amount and mix of raw materials arrive on time where needed. Upon receipt of raw materials, the manufacturer could send electronic payment to the suppliers. Conversely, the manufacturer might look upstream to ensure that primary and secondary suppliers have sufficient capacity to meet its upcoming production demands.

Looking downstream, a manufacturer can monitor inventory balances and movement patterns of its product lines to ensure that distributors have sufficient quantities of products on-hand. When new patterns emerge, for instance the activity rate for product A increases significantly for distributor X but decreases for distributor Y, the manufacturer can adjust its production and shipping schedules accordingly. Looking further downstream, distributors can monitor shelf patterns at retail locations, thereby making sure that product stock-outs do not occur. Finally, retailers can monitor changing consumption patterns of customers and adjust product mix and shelf locations correspondingly.

### *Using ICT to Create New Business Models*

When ICT first arrived on the business scene, managers initially automated existing processes, rather than envisioning how ICT could be used to conduct business in new and innovative ways. Eventually business managers began to understand the potential of ICT to support radical changes in internal business practices; hence, they viewed the development and implementation of ERP systems as value-added endeavors for their business organizations. To some extent, business entities are experiencing a similar evolutionary adaptation to ICT in the realm of integrated supply chains. That is, the previous example reflects how business managers are using ICT to automate existing

**FIGURE 1**
**The Digitally Integrated Business Entity**

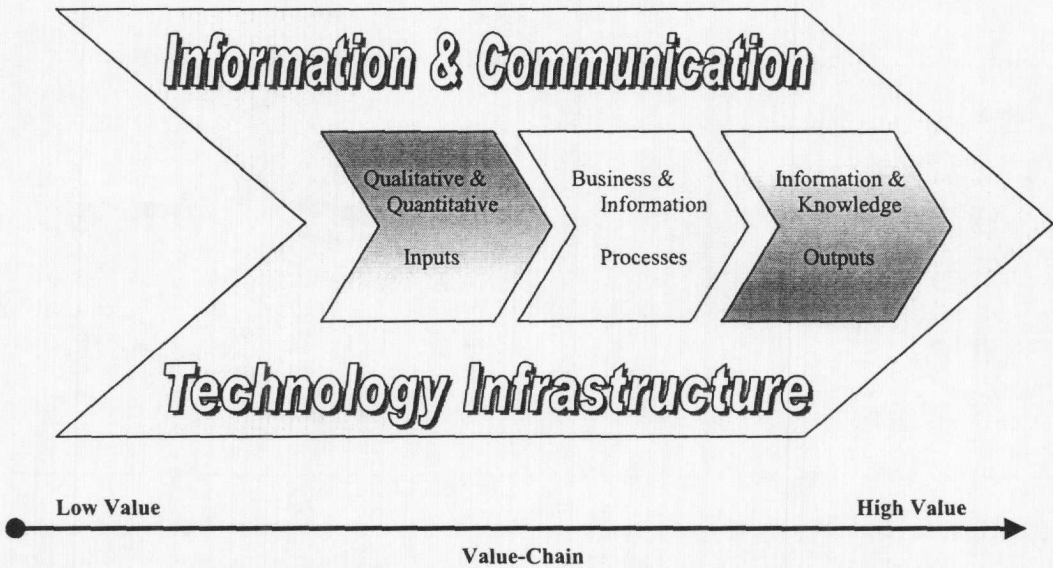
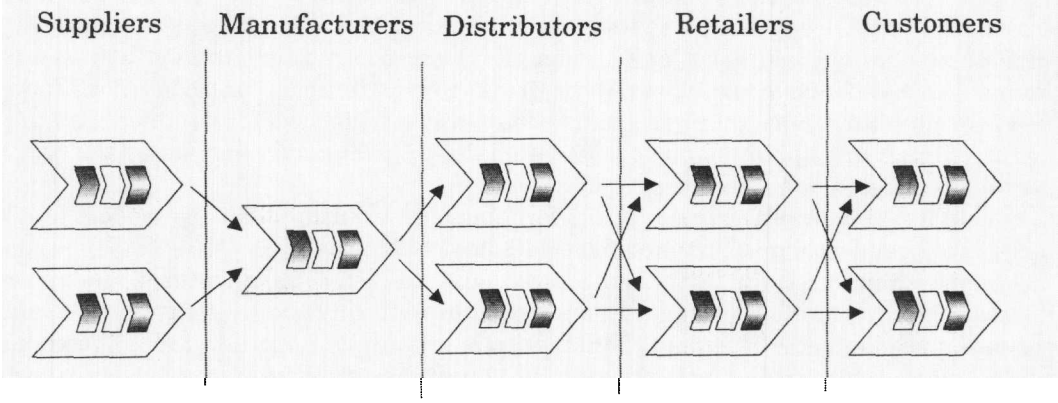


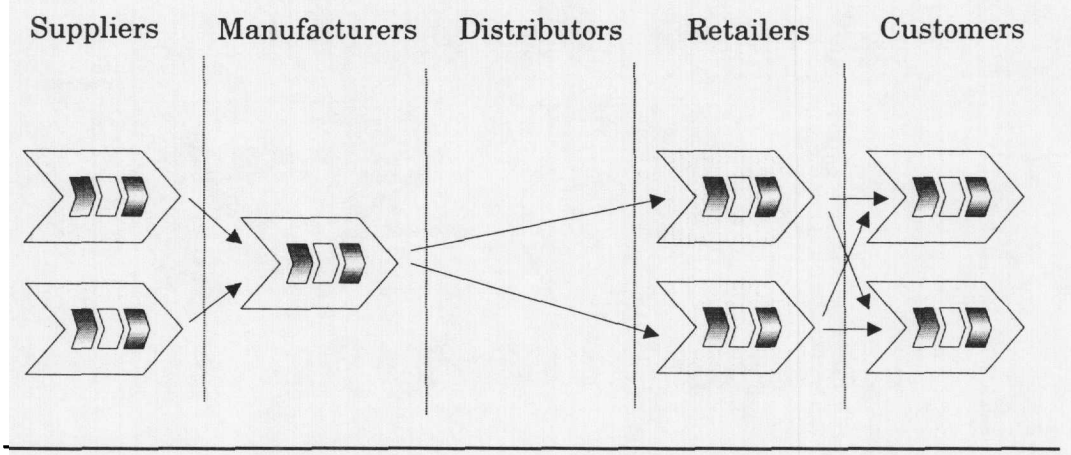

**FIGURE 2**
**The Digitally Integrated Conventional Supply Chain**




supply-chain models. However, ICT further allows new supply-chain and business models to emerge.

For example, the hybrid supply chain shown in Figure 3 depicts a scenario where manufacturers deal directly with retailers, thereby bypassing the entire distributor network. For instance, assume that a manufacturer receives real-time inputs from retailers, via shelf sensors and cash registers, regarding the shelf location of each product, the rate at which the product is being purchased, the types of discount coupons being redeemed, and the number of units remaining on store shelves. Leveraging on such intelligence

**FIGURE 3**
**The Digitally Integrated Hybrid Supply Chain**




gathering, the manufacturer could monitor stocks and flows at retail stores, and continuously fine-tune its production and shipping schedules. Additionally, manufacturers and retailers could enter into agreements where manufacturers assume stocking responsibility and retain legal title until the products are sold. A scenario of this nature, often referred to as "vendor managed inventories," gives manufacturers greater control over their products, while relieving financial and human resource burdens heretofore imposed on retailers.

Taken one step further, manufacturers might begin to wonder why they use retailers at all, since they can create virtual storefronts on the Web, thus dealing directly with customers and allowing for creation of the virtual supply chains illustrated in Figure 4. Such economic arrangements, legitimatised under terms and conditions specified in "collaboration partner agreements," are very efficient, as they reduce the number of layers from suppliers and customers, thereby dramatically increasing the firm's response time and adaptability.

Last, but certainly not least, ICT offers new and exciting business models previously not possible, such as virtual enterprises depicted in Figure 5. Using this type of e-commerce configuration, a virtual enterprise can establish complex interdependencies with suppliers, manufacturers, and customers, thus offering a wide array of goods and services to consumers. The virtual enterprise is organic in nature because the structures, relationships, rules, procedures, and boundaries of business relationships can adapt to ever-changing environmental conditions.

## ACCOUNTING AND INFORMATION SYSTEMS—SIMILARITIES AND DIFFERENCES

The emergence of ICT over the past few decades led to a new business and academic discipline—information systems (IS). Given that the vast majority of business event processing in organizations deals with accounting transactions, it is no surprise that the disciplines of accounting and IS share a high degree of commonality; yet key differences exist between the two disciplines as well.

**FIGURE 4**
**The Digitally Integrated Virtual Supply Chain**

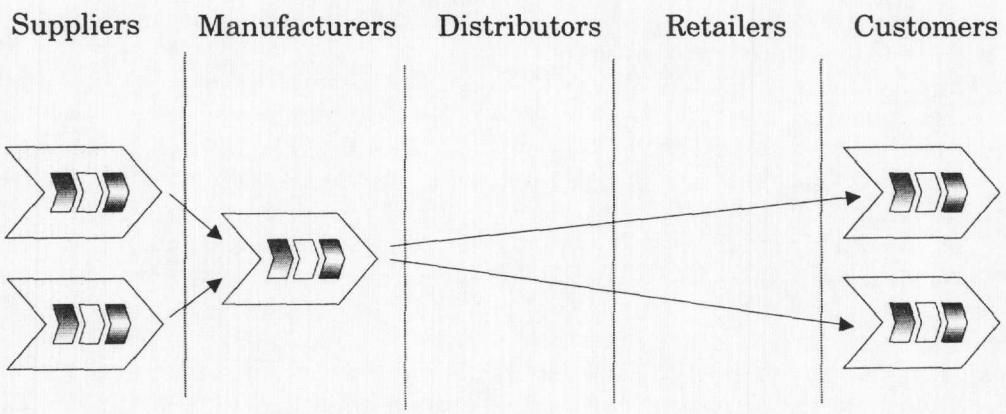
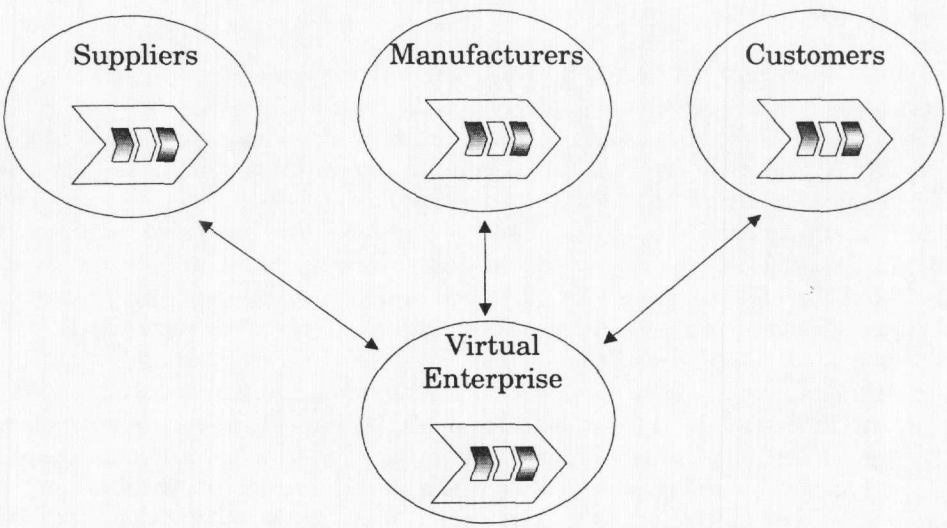



**FIGURE 5**
**The Digitally Integrated Virtual Enterprise**




**Similarities between Accounting and Information Systems**

The input-process-output value chain of a business entity shown in Figure 1 reflects one area of convergence between the accounting and IS disciplines. For instance, both disciplines examine ways to maximize the efficiency and effectiveness of recording economic data, where issues such as editing and validating input data are of paramount concern. Additionally, both disciplines investigate various approaches to automating the immediate capture of economic events at their source as they occur via

computer-to-computer interactions, point-of-sale applications, self-service features, and so on. Regarding the processing of economic events, both disciplines seek to integrate ICT into business processes and ensure the security of corporate databases. The accounting and IS disciplines also endeavor to disseminate reliable and timely information to decision makers, and advance understanding with respect to managing business knowledge throughout the organization.

The accounting and IS disciplines also seek ways to improve modeling techniques aimed at conveying semantic representations of intra- and inter-enterprise systems. Scholars who engage in intellectual pursuits of this nature categorize their research as design science. Such research is vitally important to the creation of sound "architectural drawings" and "engineering plans" for building reliable systems.

The accounting and IS disciplines further investigate issues that fall into the realm of social science. For instance, at the individual level, researchers explore various ways to involve users in systems development and implementation projects, improve decision making via decision-support and group-support systems, and create system interfaces designed to enhance the efficiency and effectiveness of human-to-computer interactions. At the organizational level, the ultimate goal is to create information systems that best leverage firm resources to maximize profitability and competitiveness. With this objective in mind, researchers strive to use ICT in ways that support business process (re)design efforts, improve intelligence gathering, such as data warehouses, data marts, and knowledge bases, and produce the new business models reflected in Figures 2 through 5.

**Differences between Accounting and Information Systems**

Accounting can be viewed as a specialized information system aimed at recognizing, measuring, recording, processing, and reporting economic events affecting business entities. A noticeable divergence between the accounting and IS disciplines centers on the economic implications of business events. The accounting discipline expends a great deal of effort deciding which economic events must be recognized and how they should be measured. Economic concerns of this nature are not addressed in the IS literature, as event and measurement rules are taken as given. Once these important issues are resolved and codified, qualified economic events must be recorded, processed, and reported.

As mentioned earlier, both disciplines investigate similar intra-enterprise issues; however, the IS discipline is most concerned with technical aspects of incorporating ICT into organizations, whereas the accounting discipline is most interested in leveraging ICT to improve business performance while simultaneously maintaining effective internal controls. With respect to system design matters, accountants help to insure that sound internal controls are developed and integrated into information systems, such as (1) editing and validating input data, (2) tracking the integrity of information throughout processing, storage, and retrieval activities, (3) maintaining reliable audit trails, and (4) securing operating systems, networks, software applications, and databases so that only properly authorized individuals have access to financial information. To the extent that internal controls of this nature cannot be incorporated into the system, accountants must design compensating controls around the system.

Regarding business process (re)design efforts, IS researchers again tend to focus on technical matters, such as how to build systems that are adaptable to various business process models. In contrast, the accounting discipline focuses on developing innovative

ways to (re)design business and information processes to improve the reliability, relevance, and timeliness of financial and nonfinancial business reporting. For example, accounting researchers might redesign business processes to incorporate a more comprehensive set of firm performance indicators, such as balance scorecard metrics, whereas IS researchers concentrate on how to technically capture and process such input.

On the output side of the value chain, the business vs. technical distinction between the accounting and IS disciplines emerges once again. The accounting discipline takes a "decision usefulness" approach to reporting business information. Researchers in this area expend a great deal of effort identifying the nature of financial and nonfinancial information needed by decision makers, translating critical business information into knowledge, integrating knowledge bases throughout the organization, and designing individual- and group-level decision support systems. Although the IS discipline is also involved with information dissemination, knowledge management, and decision support, IS research focuses not on content issues, but on the technical aspects of using ICT for such purposes.

Business process (re)design efforts can extend beyond the intra-enterprise boundary to include inter-enterprise linkages, such as those represented by Figures 2 through 5. Creating and maintaining externalities of this nature beget a host of business and accounting risk issues for trading partners. For instance, because trading partners are concerned about potential business interruptions during the implementation and operation of inter-enterprise systems, contingency and backup plans must be developed and tested. Trading partners also monitor and control external transactions and agreements to ensure that all parties in the inter-enterprise network live up their trading partner arrangements, else a weak link in the chain could have serious business and financial implications for all interdependent trading partners. While the accounting discipline focuses on these types of implementing, monitoring, and controlling issues, the IS discipline concentrates on the technical aspects of establishing and maintaining inter-enterprise relationships.

Finally, the accounting discipline provides public assurances regarding the extent to which financial statements fairly reflect the financial position of the enterprise and the ICT infrastructure is reliable. The information systems discipline is uninvolved with providing such assurances. These similarities and differences between the accounting and IS disciplines form the basis for the accounting value chain, presented next.

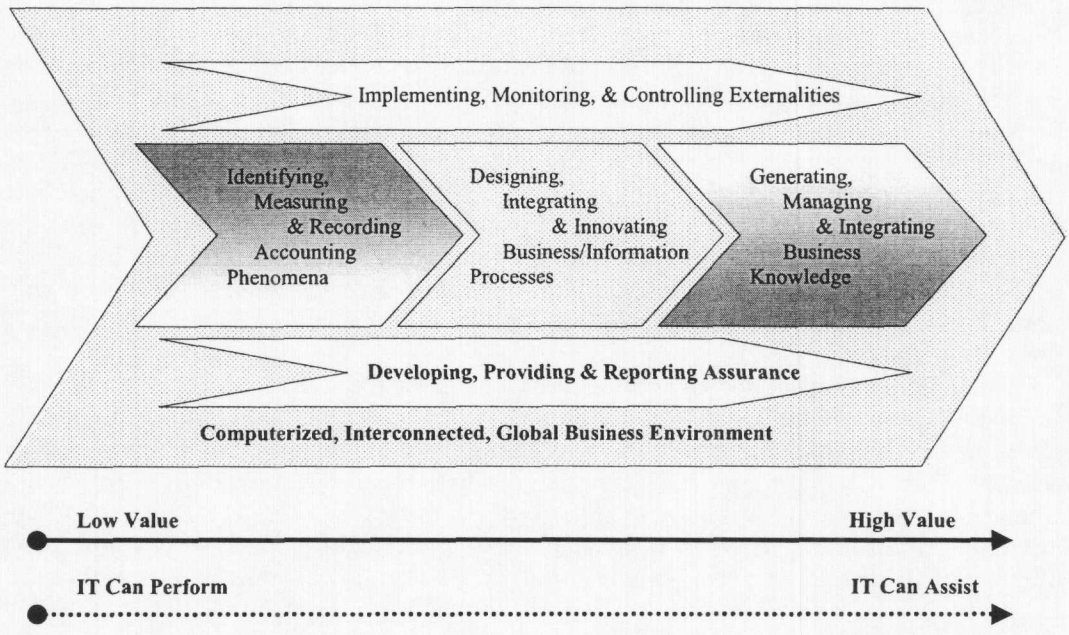
## THE ACCOUNTING VALUE CHAIN

The accounting value chain shown in Figure 6 adapts and extends concepts imbedded in enterprise (Porter and Millar 1985), assurance (Elliott 1994), and information (Elliott 1995) value chains. Using the accounting value chain as a guide, this section addresses one of the most important questions and challenges to the accounting profession. That is, how can accountants add value to business organizations in today's computerized, interconnected, global business environment?

### Capturing Economic Events

On the low-value end of the spectrum fall the traditional functions of identifying, measuring, and recording accounting transactions as they pierce the boundary of the entity. Since most of these functions are routine and predictable, cleverly written computer programs can handle most of these activities. Sometimes, economic events unfold that are new or unusual to the firm and require that a properly trained accountant intervene.

**FIGURE 6**
**The Accounting Value Chain**




However, on the whole, data-capturing tasks performed by accountants in the past have been supplanted by information technology. Because real-time event-capturing processes are mature and reliable, accounting researchers have few opportunities in this area to add incremental value to extant theory or practice.

### Processing Economic Events

The next phase of the accounting value chain deals with converting data into meaningful information streams. As with input activities, computerized processing of accounting transactions is routinely automated. Reliable accounting controls are built into most information-processing systems, hence the integrity of such systems is quite high. For instance, automated checks and balances, coupled with security features, can insure that data are not lost, corrupted, or altered during processing, storing, and retrieving activities. Future research in this area will not concentrate on ICT alone; rather, it will focus on how to leverage ICT to develop and integrate innovative business process models.

### Disseminating Business Knowledge

The high-value side of the accounting value chain deals with generating, managing, and integrating business knowledge. As suggested by Elliott (2001), knowledge leveraging is the most important and distinguishing competency of professional accountants. While many information technology tools exist to assist in this regard, such as database query languages, data warehouses, and data marts, it is humans who ultimately apply reason, judgment, and interpretation to informational patterns—which in turn begets new knowledge. Accountants can play valuable roles in identifying,

processing, and utilizing business knowledge, and disseminating such knowledge to other information consumers inside and outside of the organization.

**Developing Externalities**

A relatively new arena where accountants can add value to the business organizations concerns the development of external linkages to other firms in the environment. As discussed previously, business networks of this nature allow for the formation of emerging e-commerce models across value and supply chains. However, the creation of externalities evokes a host of implementing, monitoring, and controlling concerns relevant to accountants.

For example, when a firm establishes digital connections with another firm, the rules of engagement must be carefully specified. That is, an exchange protocol must be agreed upon and collaborative partner agreements must detail the responsibilities, authorizations, and restrictions of each party. Once external linkages are in place, each party must monitor and control informational flows and exchanges to insure that the privacy, confidentiality, and security rights of affected parties are protected. Since the development of external digital linkages has significant internal control implications, accounting researchers face a host of new opportunities in this regard.

**Providing Assurance**

There are many new and exciting opportunities where the accounting profession could add value to managers, investors, and society through an expanded line of assurance services. The most notable, yet traditional, form of assurance is manifest in the auditor's opinion regarding the fairness of financial reporting. However, the heavy dependency on ITC within and across business organizations has opened doors to an entirely new line of potential assurance services.

For instance, the American Institute of Certified Public Accountants (AICPA) and Canadian Institute of Chartered Accountants (CICA) considered business-to-consumer assurance in the form of WebTrust℠. More recently, the AICPA/CICA rolled out a product called SysTrust℠, which reflects a type of business-to-business assurance. Other assurance services will likely emerge over time, such as assurance over the quality and reliability of firms' business and information processes, located in the middle of the accounting value chain, and assurance over knowledge management tools and techniques, located on the upper end of the spectrum. Last, but certainly not least, a new breed of e-commerce assurance service opportunities will likely emerge as firms begin to link their internal systems to one another, thereby forming unique and innovative e-commerce models.

**Synergistic Research Opportunities in Accounting**

The accounting value chain illustrated in Figure 6 provides a structure for pondering and framing a wide array of research questions for accounting scholars. The more prominent issues investigated by accounting information systems researchers are reflected in an upcoming AIS research monograph sponsored by the Information Systems Section of the American Accounting Association.[1] Since most of these issues have been directly or indirectly addressed above, this section identifies representative areas where accounting information systems and other accounting researchers can collaborate on research projects.

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[1] Arnold, V. and S. Sutton, *Researching Accounting as an Information Systems Discipline*, Information Systems Section of the American Accounting Association, forthcoming.

### *Business Reporting Taxonomies*

The AICPA, among dozens of supporters, is involved with developing a technology-based framework to allow for the automatic extraction and exchange of financial and nonfinancial information across multiple, disparate software applications. Realization of this framework will facilitate many desired goals, such as the creation of global supply chains, immediate dissemination of financial statements to the public, transmission of regulatory filings to governmental agencies, and so on. The technology behind this framework is called eXtensible Business Reporting Language (XBRL), also known as the digital language of business. More information about XBRL can be found at http://www.xbrl.org.

In order to realize the full potential of XBRL, each data item in a corporate database must be precisely defined and related to other data items. The end result of this mapping process is called a taxonomy. For example, if all firms engaged in producing widgets agree on a standardized taxonomy for their industry and map their corporate data accordingly, then financial and nonfinancial information could flow freely across the industry, regardless of the types of software and hardware being used by the firms. Taken a step further, if trading partner firms involved with the industry's supply chain have access to the taxonomy, then they, too, can easily share business information. This example can be extended to a global setting as well. Research opportunities in this area seek to develop taxonomies to be used for various industries, regulatory agencies, accounting jurisdictions, supply chains, and so on. For instance, AIS researchers could collaborate with financial accountants on the development of XBRL taxonomies focused on financial reporting, including global taxonomies, and with managerial accountants on taxonomies dealing with internal reporting and supply chains.

### *Continuous Financial Reporting*

In an effort to be more responsive to information consumers, publicly traded companies are considering the merits of providing financial statements on a more frequent basis than the current quarterly reporting period. Many issues and concerns arise with respect to continuous financial reporting, such what is meant by continuous (e.g., monthly, weekly, daily), how to deal with accruals, deferrals, and estimates in a continuous reporting environment, and the impact of continuous reporting on the capital market. Regarding the latter issue, financial and AIS researchers could simulate and compare various reporting frequencies, such as quarterly-to-monthly vs. quarterly-to-weekly, and conduct either behavioral or experimental economic studies to investigate the impact of more frequent reporting on stock price valuations and market volatility.

### *Continuous Assurance*

To the extent that continuous financial reporting becomes a reality, the accounting profession must deal with the concomitant demand for continuous, or at least more frequent, assurance. The potential research issues in this area include: (1) the type of assurance to render—audit or review, (2) the marketplace demand for continuous assurance, (3) the impact of continuous assurance on the audit process, and (4) ways that audit firms can leverage ICT to render an effective yet efficient audit under these circumstances. For example, auditing and AIS researchers could collaborate on projects investigating the efficacy of various types of ICT, such as embedded audit modules, for monitoring client transactions and activity levels and insuring that firms do not change financial information on their Internet sites after the auditors have provided assurance.

### *Quality of Earnings*

The possibilities of continuous financial reporting and related assurance beget questions concerning quality of earnings. For instance, to what extent will more frequent reporting affect a firm's ability to manage earnings since accruals, deferrals, and estimates must be more closely tied, in real-time, to related economic events? Could a credit sale transaction captured at a cash register include estimated allowances for doubtful accounts and returned goods based on a percentage of the sale amount? Will more continuous assurance affect the nature and extent of earnings management attempts if the firm believes that auditors are more likely to detect such activity in a continuous assurance scenario? AIS and audit researchers can certainly team up to tackle such issues.

### *Market Value of Accounting Systems*

The impact of ICT on accounting systems has evolved from fairly simple general ledger applications to extremely complex ERP systems. When firms adapt from one type of system to another, they typically incur huge outlays of financial and human capital. Questions arise regarding the underlying value of embarking on enormous capital projects of this nature. One aspect of "value" can be viewed from the perspective of investors. For instance, how do investors respond when a firm announces that it plans to adopt an ERP system? While this question deals with investors' initial beliefs regarding ERP adoption, a follow-up question could focus on the extent to which ERP systems actually improve firm performance over time. Recently, AIS and financial accounting researchers joined forces to examine the first question (Hayes et al. 2001). Reading a study of this nature can help AIS and non-AIS researchers envision the end result of such collaborative efforts.

### *Internal Value of Accounting Systems*

In a similar vein, researchers could investigate the value of enterprise-wide information systems to internal decision makers and business processes. For example, to what extent do ERP systems improve the timeliness, reliability, and relevance of decision-making information throughout the firm? Do enterprise-wide systems offer a realistic framework for creating value-added data warehouses and data marts? To what extent can the firm attribute quality improvements in critical success factors, such as services, products, processes, and morale, to enterprise-wide systems? AIS and managerial accounting researchers could collaborate on these and related issues.

### *Decision Support Systems*

Advances in ICT facilitate the development of a host of potential decision-support systems at both the individual and group level. For instance, decision-support systems can be developed to help design effective internal control structures, configure optimal business processes, and assess business and audit risks. Issues such as interface design, information content, training value, and user reliance are some of the more fruitful areas of inquiry. Depending on the context of the proposed decision support system, AIS researchers can work with financial, managerial, tax, and audit researchers.

### *Knowledge Management*

One of the more promising areas of value creation for organizations is to capture, store, process, and disseminate business knowledge. Firm- and industry-specific knowledge is accumulated over time on key issues such as research and development, marketing strategies, customer relations, process quality, and so on. A "best practices" knowledge base dealing with topics of this nature can be developed so that institutional

knowledge can be transferred across persons, settings, and time to facilitate organizational and individual learning and growth opportunities. AIS and managerial researchers can investigate critical design issues in knowledge management systems and ways to encourage employees to rely on such systems as electronic colleagues.

***Risk Assessment and Management***

When firms switch from one accounting system to another, say from a traditional general ledger system to an ERP system, the nature and extent of business, internal control, and audit risks can change considerably. For instance, ERP systems are more likely than general ledger systems to cause business interruptions due to the tightly integrated nature of ERP systems coupled with programmed workflow automation from one business process to another. In addition, security risks are often heightened with ERP systems, since corporate information is stored in a relational database and a compromise of the database, via viruses, hackers, employees, and the like, can ripple throughout the organization.

Company managers and internal and external auditors must be aware of risk differentials across accounting systems and revise contingency strategies, internal controls, and audit plans accordingly. AIS, audit, and managerial scholars can develop projects aimed at delineating risk profiles of various technology-based accounting systems. Once unique risks are identified, AIS and audit researchers can examine the extent to which external auditors are aware of the unique risks posed by different systems and how they either do or should adjust audit plans in response to differential risk profiles. A recent study by Hunton et al. (2002) represents an example how AIS and audit researchers are working together in this area.

***Systems Reliability Assurance***

The new SysTrust℠ assurance service proposed by the AICPA/CICA holds great potential as a revenue generator for CPA/CA firms. SysTrust℠ attests to the reliability of a firm's information systems. For example, company management would make assertions about one or any combination of the following reliability dimensions of its information systems: availability, security, and integrity and maintainability.[2] Additionally, management can narrow the scope of the system to which the assertions apply, such as accounts receivable only, all financial applications, or the entire ERP suite of applications. Then, independent auditors are hired to test for compliance with stated assertions and offer related assurances to the public in the form of an opinion.

A firm could voluntarily request a SysTrust℠ engagement to provide comfort to current and potential trading partners, or a potential trading partner might demand that the other partner receive such assurance before entering into a contractual arrangement. AIS, audit, and financial researchers can collaborate on projects designed to investigate various issues, such as (1) the perceived value of placing assurance on various combinations of systems reliability dimensions, (2) how companies and audit firms can conduct cost-benefit analyses of SysTrust℠ engagements, and (3) risk factors affecting the market demand for systems reliability assurance.

[2] These four dimensions of systems reliability represent the four principles of SysTrust℠.

## SUMMARY

As highlighted throughout this commentary, information and communication technologies have radically transformed the nature of business and accounting practice. Accordingly, the manner in which accountants can potentially add value to economic entities and society is undergoing a metamorphosis. As suggested by the accounting value chain shown in Figure 6, many traditional accounting tasks dealing with recording and processing of accounting transactions can be reliably automated. Thus, accountants add little incremental value to organizations in this regard anymore. Rather, an accountant's worth is now reflected in higher-order critical-thinking skills, such as designing business processes, developing e-business models, providing independent assurance, and integrating strategic knowledge.

Many of the research issues reviewed in this commentary are interlaced with related topics in financial accounting, auditing, managerial accounting, and taxation. Methodological approaches used to investigate accounting information systems research questions, such as scientific modeling, archival analyses, and behavioral experiments and qualitative inquiries, are also common across accounting domains. Given such complementary interdependencies, the academic community would be enriched if AIS scholars were to collaborate on research projects with other accounting researchers, where possible, as resulting synergistic relationships will most certainly produce high-quality, relevant studies that could dramatically shape the future of the accounting profession and business practice.

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